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$$\text{Now } BC^2=AC^2+AB^2-2AC.AB\cos\alpha=5b^2-4b^2\cos\theta.$$

$$\therefore CD=\tfrac{1}{2}b\sqrt{(5-4\cos\alpha)},\text{ and } 4AD^2=2(AC^2+AB^2)-BC^2$$

$$=5b^2+4b^2\cos\alpha.$$

$$\therefore AD=\tfrac{1}{2}b\sqrt{(5+4\cos\alpha)},\text{ and } AO=\tfrac{1}{3}b\sqrt{(5+4\cos\alpha)}.$$

$$\text{Also } \cos\theta=\frac{AC^2+AD^2-CD^2}{2AC.AD}$$

$$=\frac{b^2+\frac{1}{4}b^2(5+4\cos\alpha)-\frac{1}{4}b^2(5-4\cos\alpha)}{2b.\frac{1}{2}b\sqrt{(5+4\cos\alpha)}}=\frac{1+2\cos\alpha}{\sqrt{(5+4\cos\alpha)}}.$$

$$\therefore \sin\theta=\frac{2\sin\alpha}{\sqrt{(5+4\cos\alpha)}}.$$

Since the uniform weight, $3W$, acts at the centroid O, we have, by taking moments about A,

$$W.b\sin\phi=3W.\tfrac{1}{3}b\sqrt{(5+4\cos\alpha)}\sin(\theta-\phi).$$

$$\begin{aligned}
\therefore \sin\phi&=\sqrt{(5+4\cos\alpha)}\sin(\theta-\phi).\\
&=\sqrt{(5+4\cos\alpha)}(\sin\theta\cos\phi-\cos\theta\sin\phi)\\
&=2\sin\alpha\cos\phi-(1+2\cos\alpha)\sin\phi\\
&=2\sin\alpha\cos\phi-2\cos\alpha\sin\phi-\sin\phi\\
&=\sin(\alpha-\phi).
\end{aligned}$$

$$\therefore \phi=\tfrac{1}{2}\alpha.$$

Also solved by J. Scheffer and S. G. Barton.

NUMBER THEORY AND DIOPHANTINE ANALYSIS.

Edited by Dr. G. E. Wahlin, University of Illinois.

174. Proposed by B. KRAMER, Student, University of Pittsburg, Pittsburg, Pa.

Find a general solution of $x(x+a)=y^2$, a, x, and y being integers. Given a, required to find x to satisfy conditions.

II. Solution by E. B. ESCOTT, Ann Arbor, Mich.

The solution by Prof. F. L. Griffin is defective. His statsment that $\dfrac{n^2}{a-2n}$ is integral only when n is a multiple of $a-2n$ is not true.

For example, if $a=15$, $n=3$, $\dfrac{n^2}{a-2n}=1$, but $\dfrac{n}{a-2n}=\frac{1}{3}$.

Correct solution. Let the highest common divisor of x and $x+a$ be m. Then evidently the solution is

$$x=mr^2\ldots(1),$$
$$x+a=ms^2\ldots(2),$$
$$y=mrs\ldots(3).$$

From (1) and (2), $a=m(s^2-r^2)$.

Then if a is given, we can put s^2-r^2 equal to the different factors of a, and m equal to the remaining factor. s^2-r^2 may be put equal to any factor of a excepting the double of an odd number.

Example. $a=15$. If $a^2-r^2=15$, $s+r=15$ or 5, $s-r=1$ or 3,

$$\left.\begin{array}{l} s=8 \\ r=7 \end{array}\right\} \text{or} \left.\begin{array}{l} s=4 \\ r=1 \end{array}\right\},\ m=1.$$

These give $x=49$, $y=56$, $x=1$, $y=4$.

This last solution is omitted in Professor Griffin's table owing to his incorrect analysis.

If $s^2-r^2=5$, $m=3$, $x=12$, $y=18$.

If $s^2-r^2=3$, $m=5$, $x=5$, $y=10$.

179. Proposed by V. M. SPUNAR, Chicago, Ill.

Solve the equation in integers, $x^n+y^n+z^n+xyz=100x+10y+z$.

Solution by A. H. HOLMES, Brunswick, Maine.

Put $xyz=100x$. $\therefore yz=100$, and $z=100/y$.

$\therefore x^n+y^n+\dfrac{100^n}{y^n}=10y+\dfrac{100}{y}$; or $x^n=10y+\dfrac{100}{y}-y^n-\dfrac{100^n}{y^n}$.

For n even, $10y+\dfrac{100}{y}>y^n+\dfrac{100^n}{y^n}$.

Put $n=2$. Then $10y+\dfrac{100}{y}>y^2+\dfrac{10000}{y^2}$.

But $y=\dfrac{100}{z}=1, 2, 4, 5, 10, 20, 25, 50$, or 100. $\therefore n=1$ and $x=9y$.

$$\therefore n=1:\ \left|\begin{array}{l} x=9,\ 18,\ 36,\ 45,\ 90,\ 180,\ 225,\ 450,\ 900. \\ y=1,\ 2,\ 4,\ 5,\ 10,\ 20,\ 25,\ 50,\ 100. \\ z=100,\ 50,\ 25,\ 20,\ 10,\ 5,\ 4,\ 2,\ 1. \end{array}\right.$$

Put $xyz=10y$. $\therefore xz=10$, $z=\dfrac{10}{x}$ and $x^n+y^n+\dfrac{10^n}{x^n}=100x+\dfrac{10}{x}$ or $y^n=$ $100x+\dfrac{10}{x}-x^n-\dfrac{10^n}{x^n}$.